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Experience at LLNL - Final Report for SJSU Research Foundation

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FINAL REPORT

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The past two years at Lawrence Livermore National Laboratory has been an enriching experience that I will remember for a long time. It has taught me many skills I can utilize towards my future career as well as giving me insight into what is involved in the field of research in physics. With the help of Professor Wharton and Mike Messerly at Lawrence Livermore National Laboratory I have come away from this experience with knowledge and skills to go forth and jump-start my career.

When I first started at the lab, I did not know what to expect. I was intimidated by the fact that I was to work with brilliant minds that shape the science of tomorrow today. I was quick to learn that they were regular people like the rest of us. I started by working on a system we call the “tweaker”. The tweaker is composed of fiber ports supplying the light as the input. It goes through a movable stage with mirrors which move back and forth allowing us to delay the arrival time. The light is then reflected from a mirror to a grating that spreads out the pulse in space. The stretched pulse then traces its path back to fiber port to complete the desired effect (a stretched pulse in time, not space). (See Figure 1).

I have also had experience in modeling behaviors of light pulses with Mathematica and Microsoft Excel. I modelled the polarization of light through different optical elements in the system to see if the proposed system was viable to pursue. I used Jones Matrixes as a mathematical tool to simulate the various effects the optical elements would have on the pulses

being simulated. This was the first time I've had to use the computer to model real-life behavior of the light so it was delightful and challenging. This experience also fueled my interest in computational physics and I now plan to pursue my masters degree in computational physics.

I started working on fiber-based systems after completion of the tweaker. I learned how to fusion splice the fibers to "connectorize" the ends of the fibers for easier handling. In time I learned how to make fiber-based amplifiers by fusion splicing WDM with a length of amplifying medium and packaging them. Fiber-based components make it easy to create amplifiers capable of amplifying signals by +20dB.

I've also worked on integrating different systems by constructing electrical circuits consisting of different logic gates. In completing this project I've had to consult the manuals of each power source and learn how to automate features by controlling the voltages coming out of the photo detectors. I made the circuits from scratch and constructed the circuits by hand. It was a nice review of basic electronics and at the same time a learning experience on automating data acquisition. I've also learned the lesson of making things work for your particular needs instead of being limited to what the hardware company has suggested. I believe this will be a great asset to my career because I'll be able to think outside of the box and come up with creative solutions to problems.

The final project I worked on incorporated everything I've learned throughout my experience at Lawrence Livermore National Laboratory. My task was to build a recirculating pulse stretcher, which is similar to the tweaker I made earlier, but it required the ability pick out specific pulses by the use of AOMs. The initial pulses are supplied by the oscillator and goes through an AOM to pick out a pulse. It then goes through the system similar to the tweaker to spread the pulse. Another AOM at the end of the system picks out the desired pulse and it is

amplified before reentering the system to be stretched again. The design allows us to specify how many rounds the pulse goes through the system before we pick it out—which allows us to specify how much stretching we allow the pulse to go through (Figure 2 – recirculating pulse stretcher – courtesy of LLNL)

My overall experience at LLNL has been life-changing as it opened my eyes to what is involved in the field I would like to go into. It allowed me to enjoy learning about how things are used in the industry. My time at LLNL has ended but I come away with knowledge, experience, and skills to go forth and pursue my career in physics.

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Figure 1: The Tweaker

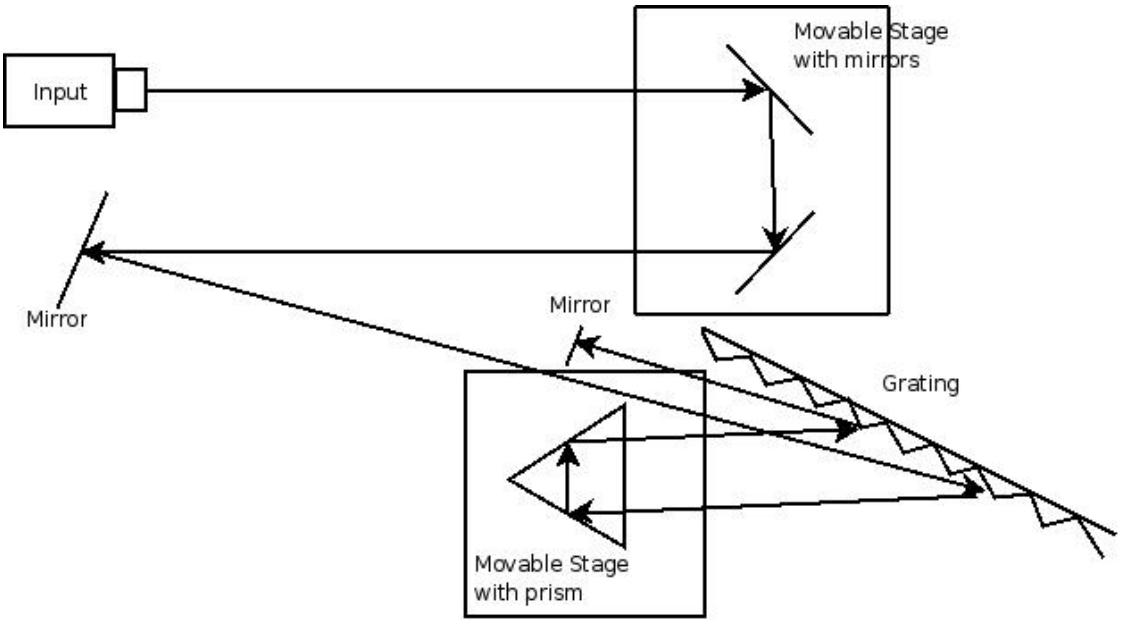

Figure 2: Recirculating Pulse Stretcher